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Chapter 9: Barcoding – the Inventory Control Project

1 Introduction

The Bodleian Libraries' main collections had never been barcoded, so during a period of 22 months the Inventory Control Project transformed the situation by barcoding and updating the catalogue for over seven million books. This chapter describes what was known about the collections and the various methods that were employed to barcode them. It also considers the staffing models and how it overcame the many challenges faced in such a time critical project.

2 Scale of the project

During July and August 2009, a pilot project was undertaken to trial a workflow for barcoding modern monographs. The intention was that this would be scaled up to a project costing £1.5 million, barcoding as much material as possible within the available budget. This was intended to complement the barcoding of all newly accessioned material, which would be phased in from autumn 2009 onwards, but at this stage there was no intention of barcoding all material intended for storage in the Book Storage Facility (BSF) (see chapter 6).

Following the adoption of the Generation Fifth Applications software as the BSF Information System (BSFIS) (see chapter 10) in spring 2009 and fact-finding missions to the Harvard and Research Collections and Preservation Consortium (ReCAP) depositories in October of that year, we concluded that that no hybrid system of barcode and shelfmark retrieval would be possible. As a result, with the exception of maps, every item ingested into the BSF would need a barcode associated with an entry in the Libraries' catalogue.

This decision meant that the project would have to be scaled up beyond the initial scope and budget. A report in April 2009, shared with us by the Director of the Bibliographic Control & Processing Division at Columbia University, showed that the cost of undertaking similar work at Columbia had ranged from $0.30 to $3.00 per item, depending on the condition and complexity of the material. The final cost of the Inventory Control Project was £3.6 million to barcode just over seven million items, giving an average cost of £0.51 per item across all collections.

3 What we knew

3.1 Introduction

The Bodleian Libraries have acquired books through a variety of means throughout their lifetime. These include legal deposit, purchase, donation and exchange. Although the focus of the Inventory Control Project was on modern printed books, we knew that a certain amount of material from the Special Collections department would also be sent for temporary storage at the BSF during the renovation of the New Bodleian Library. No complete inventory of the entire collection existed. Despite eleven million records appearing on the online catalogue (which also included other libraries in Oxford) we knew that at best this only provided a collection-level description for many parts of our holdings.

The principles of operation of the BSF prescribed that every item must be barcoded. Since an item inventory did not exist we could not be sure of the exact magnitude of the barcoding task. However, we had detailed measurements of the linear shelf space occupied by collections destined for the BSF. There were 192 kilometres, which enabled us to estimate that 6.5 million items would be barcoded.

3.2 Legal deposit

Her Majesty's Revenue and Customs (HMRC) were willing to give tax relief on construction costs for those parts of the BSF that were to contain legal deposit material. Early barcoding trials in the summer of 2009 showed that identifying legal deposit material by looking at the Bodleian stamp took a few extra seconds per item. The additional cost in staff time was outweighed by the savings presented by VAT relief.

A decision was taken to identify every legal deposit item at the point of barcoding and to store it in separate chambers at the BSF, thus physically separating the existing mix into two distinct groups. The status of each item was indicated by the use of a barcode number starting with a seven for legal deposit material, or a six for non-legal deposit material.

Considerable institutional knowledge of the Bodleian's collections from longstanding members of staff was used to estimate the proportion of legal deposit material as part of the total. No definitive evidence existed of the legal deposit status of items received before the 1920s, although it was possible to demonstrate that some complete collections were received through this privilege before that date. We concluded – correctly, as it turned out – that 44 % of the material could be identified as legal deposit.

3.3 Main Classification Schemes used on the materials barcoded

Most monographs received before 1988 went into one of several in-house classification schemes, applied to the physical items as hand-written spine labels and written in pencil inside the front cover. From 1883, the scheme used was the Nicholson classification, devised by Edward Nicholson, Bodley's Librarian from 1882 to 1912. This classification consisted of a three-digit number representing a broad subject area, which was further subdivided by up to four additional digits; a lower-case letter designating size, followed by a point and a further number representing number in sequence.

Example:
170 d.15 – fifteenth 'd' sized book received for subject Art, General History and Collected Biography.

17005 e.4 – fourth 'e' sized book received for subject Art, Dutch.

In addition, enumeration or sequence order within a bound volume may have been added at the end of the shelfmark, in parentheses or following a slash; this was not consistently applied and individual volumes often received individual shelfmarks.

Nicholson's classification system also contained smaller subject-specific sequences, such as the Gough Additions (Gough Adds) sequence for the topography of the British Isles.

From 1988 onwards, each physical item received by the central Bodleian Library and the Radcliffe Science Library (RSL) was assigned a unique shelfmark made up of elements to indicate academic or non-academic material, year of receipt, size and number in sequence of receipt.

Examples:
M09.C00001 – M for academic monograph; 09 for year of receipt (2009); C for sizing; and 00001 for number in order of receipt. This would be the first 'C' sized academic monograph recorded as received in 2009 by the Bodleian.

X89.G00034 – X for non-academic monograph; 89 for year of receipt (1989); G for sizing; and 00034 for number in order of receipt. This would be the 34th 'G' sized non-academic monograph recorded as received in 1989. ('X' material was invariably legal deposit material.)

This shelfmark was placed on the inside cover of the book as a machine-readable sticker containing a barcode of the shelfmark sequence and on the spine in eye-legible format. This allowed the shelfmark to act as a unique identifier linking the item to its entry on the catalogue, including uniquely identifying individual parts of multivolume sets.

Special collections sequences included Old Class (three-digit classification, letter and sequence number, similar to Nicholson classification); Year Books (two-digit year of receipt, point and number in sequence); and other systems including elements of provenance, subject and sequence number. All were handwritten on the items.

Most periodical issues received from 1883 to 1988 were assigned the appropriate Nicholson subject classification with the prefix 'Per.'. For some categories of material an alternative prefix was used, such as 'Soc.' for the publications of learned societies, 'N.' for newspapers or 'Dir.' for directories. There was a single numerical sequence of these and the monographs in the same classification and size, though these were shelved in separate sequences except in the case of 'Soc.' which was interfiled with 'Per.' to create a single running sequence.

Example:
Per. 1232 e.28 – the twenty-eighth 'e' size item for the subject Ecclesiastical History, Scottish, being a periodical.

With the exception of some Nicholson sequences such as 'N.', periodical issues received after 1988 were given a shelfmark consisting of the letter 'P', a letter to designate size and a number in sequence. No attempt was made to separate academic and non-academic material into separate sequences. Title changes may have been represented under a single shelfmark and one title may have had several distinct shelfmark sequences as sizes changed, growth space in the stacks was filled or back issues were relegated from open shelves. Titles shelved in the 'P' sequence may also have had back runs at other classification-based shelfmarks.

Example:
P.D00002 – the second 'D' sized periodical title.

3.4 Dispersal

One objective of the construction of the BSF was to rationalize the collections which were dispersed across multiple locations (Table 9.1). Historically, rapid growth in the collections had meant that sequences of material were moved to other sites to provide space for new intake. All of these dispersed collections were to be reunited at the BSF. This presented its own challenges for barcoding since the operations could not happen in a single location.

Location	Number of books	Comments
New Bodleian Bookstack	2,400,000	Main stack
Underground Bookstore	700,000	Under the Radcliffe Camera
St Cross Building	140,000	
Nuneham Courtenay repository	1,280,000	8.7 km (5.5 miles) from the centre of Oxford
SERS Warehouse, Osney	120,000	
DeepStore	1,780,000	Salt mine in Cheshire
Iron Mountain	90,000	Kemble, Gloucestershire
Total	6,510,000	

Table 9.1: Locations and collections as estimated summer 2009

4 Operations

All of the collections within the scope of the Inventory Control Project were in closed-access areas. No barcoding work was done in library reading rooms; however, as noted above, the dispersed nature of the collections meant that a number of different barcoding operations were simultaneously under way in a variety of locations.

The Inventory Control Project was to make a head start on its work; the BSF was still under construction at the start of the project, and there would be no major book moves until the BSF was fully operational. This dictated that material held in the New Bodleian stacks in Oxford would be barcoded first.

A separate project to refurbish the Underground Bookstore in Radcliffe Square required the books to be removed from there as soon as possible, so bar-

coding was prioritized to take place in this space from the beginning of operations on 8 March 2010 (see chapter 14). As this work was completed, barcoders migrated to the main bookstack in the New Bodleian and to the satellite stack in the Law Library basement at the St Cross Building about 0.8 kilometres (0.5 miles) away. All of these early collections comprised monographs and were an excellent training ground for the teams of new staff. At this time we were still designing, testing and reviewing the periodicals barcoding processes.

Teams of senior barcoders were established in vacated reading rooms and staff offices to support the barcoders' work by working directly with the online catalogue (see section 6 on Staffing). The barcoders working at the shelf were able to escalate problem items to the senior barcoders for resolution.

In October 2010 the Libraries took the decision to bring forward the barcoding of the collections stored by DeepStore in the Cheshire salt mines. By uplifting the material early we would save up to a year's worth of storage costs. We considered whether the barcoding work could be done in the cavernous salt mines or even close by, above ground, but this was dismissed on grounds of cost and concerns about working in distant locations.

The Libraries had use of a warehouse in the Osney Mead area of Oxford, known as the SERS Warehouse, which was filled with temporary shelving to store more collections. Over the last three months of 2010 these collections were barcoded and shipped to the newly open BSF, where the first collections were ingested in October of that year. By emptying this space and undertaking some minor refurbishment work we were able to configure the warehouse to receive, barcode and dispatch the DeepStore collections on a daily basis.

A detailed delivery schedule was devised and every weekday from the beginning of January until late July 2011 an articulated lorry brought 1,040 boxes containing between 11,000 and 15,000 books to Oxford for barcoding. The majority were barcoded on the same day and dispatched to the BSF the following day. (Figure 9.1)

By this time, book moving from the New Bodleian stack was well under way. In March 2011 the last of the monographs in the New Bodleian were barcoded and all efforts were focused on the periodicals collections. Again, barcoders were working at the shelf with support from desk-based staff. This work was happening in parallel to the warehouse operation and a further 15,000 items were being barcoded each day in the New Bodleian.

At the beginning of July 2011 the New Bodleian barcoding programme was three days behind schedule. We had to complete barcoding by the end of the month to vacate the building so it could be handed over to the contractors for the major refurbishment project. We increased the number of barcoders, and staff worked very hard to meet the deadline, devising new methods to speed up the rate of barcoding.

Figure 9.1: SERS warehouse filled with DeepStore deliveries

At the end of July 2011, both the New Bodleian and DeepStore barcoding operations were completed. We said goodbye to a large number of agency staff as operations scaled down. We retained some staff to continue the warehouse barcoding work as collections were shipped there from the repository at Nuneham Courtenay. A small team of staff was sent to work at Nuneham Courtenay itself on the special collections because we felt that that would provide better security. We could not undertake full-scale barcoding there because high-density roller racking presented logistical limitations on the number of places at which staff could access the shelves.

Work continued on these collections until the last was delivered in early December 2011. We then took delivery of the collection of foreign dissertations that were stored with Iron Mountain and the last book was barcoded on 20 December 2011.

5 Solutions

5.1 Use of the catalogue as an inventory tool

We agreed as an operating principle that the Libraries' catalogue would be used as the tool for representing the collections, whether or not they were catalogued at the beginning of the project.

Each barcode would be a unique identifier representing a single retrievable object, represented by a single item record on the catalogue. In order to achieve this, the decision was made to work offline, using extracts of the existing catalogue data wherever possible, with daily uploads to the catalogue.

5.2 Catalogued monographs

There was no machine-readable barcode associated with any physical item in the Libraries' collections that made it suitable for ingest into the BSF until November 2009. During 2009 the application of suitably positioned external barcodes was implemented. By January 2010 all newly received monographs had an externally placed barcode added at the point of receipt.

Although sequences from 1988 onwards had one-to-one mapping of item records to physical volumes, this was not always the case for older monograph sequences, where a single item record often represented multiple physical volumes for a single bibliographic record. In some cases one item record could represent thousands of individual volumes.

In order for offline working to be successful and efficient for these collections, we needed to add extra item records to the catalogue to increase one-to-one mapping before files of data were extracted. This was achieved by sweeping the catalogue to generate reports of records with known shelfmark indicators for multiple volumes represented by a single item record. Cataloguing staff carried out the work to add item records, often referring to the original hand-written catalogues because this was more efficient than locating the books on the shelves.

Example:
170 d.16–18 – representing three volumes with consecutive shelfmarks.

Cataloguers would edit the existing item record and add two more to result in:

170 d.16
170 d.17
170 d.18

In total over 14,000 new item records were added to the catalogue during pre-emptive work.

ReBar was an in-house piece of software developed by the systems team from existing software used for the receipt of legal deposit monographs (CroBar). It worked with an extracted database of title, author and shelfmark information taken from the catalogue, allowing the barcoder to associate a new physical barcode with each individual item. When the data captured were uploaded, the barcode then became associated with the item record on the catalogue.

For modern monographs with a barcode version of the shelfmark, or other unique barcode inside the cover, this process was relatively straightforward. The barcoder scanned the unique identifier, checked the title and author information, and then scanned the new barcode to be associated with the item. For this workflow the material did not need to be presented in shelfmark order.

For older monographs with no machine-readable identifier, shelfmark information was often inconsistently recorded on the books, with a further problem of variation of transcription in the electronic version of the catalogue.

Example:
170 d.19/1 – shelfmark written on the book
170 d.19 (v.1) – shelfmark recorded on the catalogue

Nicholson classification numbers also possessed no marker to show that a subject had been subdivided. This meant that the resulting classification sequence as found at the shelf was not repeated by the internal sequencing algorithms of the library management system. This caused a problem where a classification number with a greater number of digits came before a number with fewer digits at the shelf.

Example:
Classification number 14024 immediately precedes 1403. There is an implicit decimal point, thus the numbers are interpreted as 140.24 and 140.3.

A trial on Nicholson monographs where shelfmarks were typed into the ReBar software resulted in 25% of items not being found in the extracted files, an unacceptable failure rate.

The Student Consultancy Service, a work-experience programme for University of Oxford undergraduates, visited the Bodleian and provided recommendations in the project planning stages in 2009. Following these, the systems team developed a key for sequencing both Nicholson classification numbers and the enumerative elements following the classification number to produce files that represented the order of books as they were found at the shelf. This allowed a workflow where the barcoder established a starting point by typing in a shelfmark, referring to a computer linked the library catalogue to obtain the exact shelfmark syntax if necessary, and then progressed along the shelf using a 'Next item' button to work through the sequence.

With an estimated 2.3 million monographs in the Nicholson classification, this represented a major breakthrough for the project.

5.3 Periodicals

Before 1993 for the Radcliffe Science Library and 2003 for the Bodleian, when an issue of a periodical was received, it was recorded on a paper receipt slip. To represent this in Geac Advance, the library management system in place at the start of the project, an item record was created for the first issue held at the shelfmark location, with a summary holdings statement to record all issues held there. Readers could then specify which issues they required when requesting from the stack. This system was used both for Nicholson-classified periodicals and the modern 'P.' sequences.

Receipt of periodical issues using the serials module of the Geac software was in place for all current periodical titles by 2008. This meant that there was an electronic record for each issue received, which was used to generate a corresponding item record for the purposes of barcoding.

However, the situation was not straightforward because issues of a title received before and after automated check-in could be found at the same shelfmark, with the additional complication of boxes storing many items potentially containing both checked-in and non-checked in issues. These boxes could also potentially contain issues attached to separate bibliographic records where a change of title had occurred.

The following sections discuss the workflows developed for barcoding periodicals. The first two sections relate to barcoding when Geac Advance was in place. In July 2011 the Bodleian Libraries adopted Aleph, which required a complete change in periodicals barcoding workflows. This coincided with the deadline for the emptying and closure of the New Bodleian building and the removal of all material from the DeepStore facility. The third section below discusses the

method for barcoding periodicals stored in the Nuneham Courtenay repository using Aleph.

Two types of Microsoft Excel spreadsheet were prepared by the systems team for defined sequences: a retrospective spreadsheet and a checked-in spreadsheet. Both contained data harvested from the catalogue.

Barcoders used the checked-in spreadsheet in a first sweep of the sequence. This spreadsheet listed the checked-in item records for each shelfmark. The barcoder scanned in the barcode he or she had applied to an individual issue, or the same barcode over several rows for boxed issues. The completed spreadsheet was sent to the systems team for processing and upload to the catalogue. The data for boxed issues was used to generate bound-item records with a single barcode for each box.

The retrospective spreadsheet was used in a second sweep to barcode non-checked-in issues. The spreadsheet was prepopulated with titles and system numbers relating to each shelfmark. The barcoder chose the correct bibliographic record within a given shelfmark to reflect title changes and entered caption and volume information along with the barcode.

Due to time constraints for completion of the project and issues with training staff, recording enumeration and chronology had to be simplified to record the minimal number of levels to identify the physical item and distinguish it from others at the same shelfmark.

Example:
A bound volume containing v.1:pt.1(1977:Jan.)–v.1:pt.4(1977:Dec.) would become 1(1977).

The completed spreadsheet was sent to the systems team for processing and upload to the catalogue, with the data used to generate new item records. Control and management of the spreadsheets proved a challenging task, especially given the fact that barcoders worked in three-hour shifts, with the potential for multiple staff working on one spreadsheet over the course of a day.

For periodicals stored with DeepStore, the spreadsheets were tailored to reflect the order in which the material would be delivered. This will be discussed further in the section on technical challenges.

At a late stage of periodicals barcoding in the New Bodleian, limitations on time and the need to prioritize limited staff resources for spreadsheet generation and processing led to the introduction of a second periodicals barcoding method. This was used in the New Bodleian stack, which housed mainly, but not exclusively, non-checked-in material in Nicholson classification.

Less work was required from the systems team to prepare and process the spreadsheets. Project staff requested reports from the systems team listing unique system numbers for a defined range of shelfmarks as Excel spreadsheets.

Barcoders added rows to the spreadsheet for each physical item under the appropriate system number, capturing enumeration, chronology and barcodes. They removed rows where issues had been checked in or where the data structure did not allow automatic processing.

The spreadsheets were processed using the automated method developed for the barcoding of publisher dumps (discussed in section 5.5 on Inventory Records). The rows which were not suitable for processing by the automated method were entered directly into the catalogue by senior barcoders.

The Nuneham Courtenay repository contained both checked-in and non-checked-in periodical sequences. This material was processed on the new library management system, Aleph, between July and December 2011. Although it was possible to adapt the retrospective spreadsheet method to allow data to be uploaded to Aleph, for technical reasons checked-in material could not be treated in the same way as before.

The first stage of processing was to label checked-in issues at the shelf using a list supplied by the systems team. These were then picked and barcoded using the periodicals binding function on Aleph by senior barcoders working *in situ*. The remaining issues were shipped to the SERS warehouse for barcoding using the retrospective spreadsheet method.

5.4 Special Collections

Although a considerable proportion of the special collections had already been relocated to the RSL, collections of manuscripts, rare books, printed music, bound maps, library records and archives remained and were destined for storage at the BSF. The majority of the John Johnson collection of printed ephemera also had to be placed under inventory control.

For the rare books collections we were able to use the same barcoding processes as for the modern equivalents. However, the remaining collections were not part of the main library catalogue. Although separate catalogues and inventories existed, the only method of retrieval once the material had been moved to the BSF was through the main library catalogue. To barcode these collections, very brief inventory records were created which only included shelfmark information. This method is described briefly in the following section and in more detail in chapter 4.

5.5 Inventory records

Certain categories of material could not be barcoded using either the ReBar software or any of the periodicals workflows. This included material not entered in the library catalogue and material with minimal or overly complex associated metadata. The principle of these records was to include no bibliographic description, but to include a collection code and shelfmark, if available, for the purpose of identification and retrieval.

These records made the material available for readers, and may in future also act as the basis for projects to improve accessibility to the Bodleian Libraries' collections. Inventory records proved to be a pivotal tool in the timely completion of the project.

Named after the complicated 'Soc.' periodical sequences shelved in the New Bodleian central stack and Nuneham Courtenay, the 'Soc.' method was developed from a workflow known as the Holmes method (after the Music Librarian) that populated the catalogue with stub records for boxed, uncatalogued music scores, which were then fed into the ReBar workflow.

The representation of 'Soc.' periodicals on the catalogue presented a number of challenges on top of standard periodical problems such as changes of title. The 'Soc.' periodicals included many monographic series which were catalogued inconsistently, with sets represented by separately catalogued monograph records, periodical records, or combinations of the two. In addition, periodical titles often had substantial associated analytical cataloguing down to the article level. Finally, multiple overlapping records sometimes existed for the same title, representing different copies obtained at different times.

These complications meant that the decision was taken to ignore the existing bibliographic data and to barcode using an Excel spreadsheet method which created a minimal level record for each shelfmark with associated item records for each physical volume, containing shelfmark, enumeration and chronology.

The inventory record for Soc. 133 e.189, and its display on the resource discovery tool that sits over the catalogue database, Search Oxford Libraries Online (SOLO), is shown in Figure 9.2.

With this development, it became possible to combine stub bibliographic record generation, item record generation and barcoding into one workflow. The end result was a parallel catalogue which allowed inventory control without the need to rationalize overly complex catalogue data.

As well as being a tool for barcoding other collections with complicated associated bibliographic records such as Gough Adds and microfilms, the 'Soc.' method was widely used for uncatalogued material and collections only represented on card catalogues. In order to meet a crucial deadline to hand the New

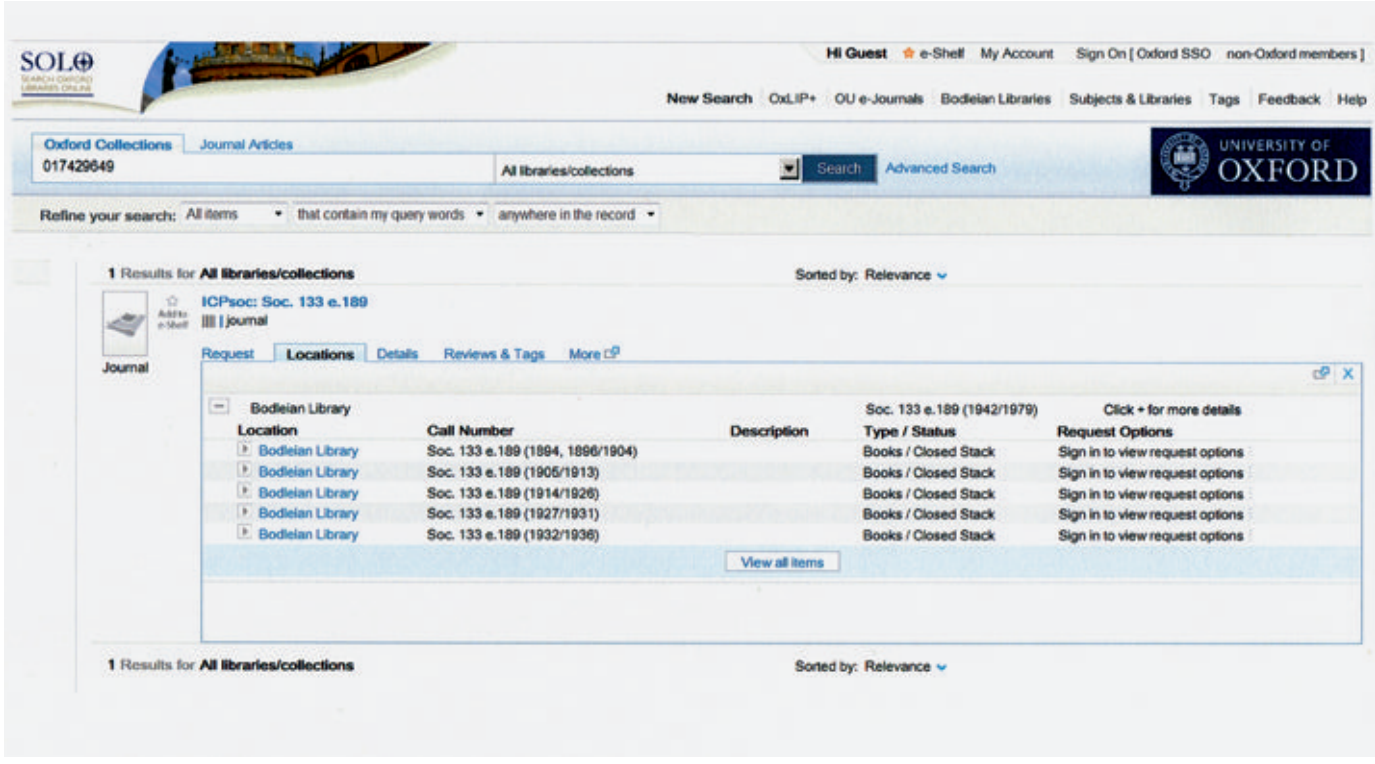

Figure 9.2: Inventory Control Project records on SOLO

Bodleian building over to contractors, the 'Soc.' method was also used to barcode outstanding escalated material from the ReBar and periodical workflows.

Among the Nicholson-era legal deposit collections, numerous sequences of books not deemed to have academic merit (predominantly fiction, children's books and paperback series) were arranged on the shelves according to publisher under a single shelfmark, and sequenced either by the publisher's serial number, ISBN or order of receipt if the former were not available. These sequences were found in the Underground Bookstore, the New Bodleian stack and the Nuneham Courtenay locations. They were known as 'publisher dumps'.

Although some titles were catalogued individually, the majority were represented by bibliographic records containing only the name of the publisher or publisher's series and a single item record sometimes representing many thousands of books. Among these non-academic sequences were many collections now seen as iconic and highly collectable, such as early Penguin books, and deemed to be part of special collections. Accordingly, many had the barcodes placed on acid free slips in order to preserve the covers.

Here, the decision was made to represent each item and build on the existing publisher records. In order to assist retrieval in SOLO and prevent excessive item records on a single bibliographic record from jamming the cataloguing module, a new bibliographic record was created for each block of 80 to 100 books, to which data was uploaded from Excel spreadsheets.

Example, for Penguin books at shelfmark 2704 e.45, from publisher number 873 to 1071:

245	00	$aPenguin books [2704 e.45/873–2704 e.45/1071]
500	##	$aInventory Control Project record.

Because publisher numbers were captured during barcoding it may be possible in future to use them to source individual catalogue records.

This workflow, of adding holdings to pre-existing records as opposed to generating new records, was given the nickname 'speedy spreadsheets'. It became crucial in offline data collection, as it allowed senior barcoder work to be managed at times when there was insufficient physical space or staff capacity to keep up with the necessary throughput of barcoding.

5.6 Escalations

Where items could not be barcoded in the main workflows, they were escalated to senior barcoders for barcoding directly onto Geac Advance, and later Aleph. For monographs, problem material included volumes of bound items, multivolume

245 00	|a Precondition analysis learning control information / |c Bernard Silver.
260	|a Scotland : |b Department of Artificial Intelligence, University of Edinburgh, |c 1984.
500	|a Inventory Control Project record.
830 0	|a D.A.I. Research Paper ; |v no.220.

Figure 9.3: Abbreviated catalogue record

sets not picked up in pre-emptive work, items either out of place on the shelf or with typographical errors in the shelfmark, material in shelfmark order but uncatalogued, and whatever else was found.

Senior barcoders were trained in problem-solving and cataloguing routines, including searching for existing bibliographic and item records, correcting errors in shelfmarks, adding binding entries and creating minimal level bibliographic records.

The number of uncatalogued monographs discovered was greater than could be absorbed by the Bodeian Libraries' existing cataloguing teams, so senior barcoders were trained to produce bibliographic records to an abbreviated standard which were suitable for retrieval using keyword based searching in SOLO.

The standard included complete 245 and 260 MARC fields, but did not routinely include authority control fields, which would have required more staff training and taken longer to produce. An exception was made for some academic series where a template-based cataloguing workflow was used, which contained repeated elements of the records common to each title, including a series entry. (Figure 9.3)

For periodicals, problems included bound-together physical items containing distinct titles, issues which should have been checked in but were not, and uncatalogued or unexpected material. Most uncatalogued periodicals were passed to the Periodicals Cataloguing section, which created full-level bibliographic records to which item records were later added by senior barcoders. This included a substantial mini-project to catalogue a donation of Soviet newspapers and embassy despatches from the Cold War era that had been donated to the library in the 1970s.

Senior barcoders usually added item records directly into the Geac or Aleph cataloguing modules, but the flexibility of Geac's GeoCat module, which functioned as a free-text editor, allowed another way of working. Known as the 'Notepad method,' this workflow involved a barcoder creating a Microsoft Notepad document consisting of lines of 852 MARC fields (recording location of item) in order to barcode long runs of either periodicals or monographs. The files were then copied and pasted into the cataloguing module to create item records. This workflow allowed immediate barcoding of material that had to be moved quickly, but often required intensive preparatory work and processing by project staff directly employed by the Libraries.

Figure 9.4: Barcoders at a trolley

5.7 Equipment

Netbook computers equipped with a barcode scanner were used for all offline data capture, with battery-charging banks set up in the central operations areas of each site to allow recharging between shifts.

In the New Bodleian operations, barcoding was undertaken away from fixed computers in confined stack areas, including roller racking and fixed shelving. A barcoding workstation was thus required to be compact, manoeuvrable and suitable for safe working over an extended period. The workstation went through several developmental stages before a final model of a two-shelved, wheeled trolley with the option of placing the netbook on an anglepoise mounting for comfortable typing and suitable screen height was adopted. Each trolley was supplied with two rolls of barcodes starting with sixes or sevens (the latter to indicate legal deposit status), acid-free paper slips, diagnostic slips for escalations, a pencil and a kick-step (Figure 9.4).

In the SERS warehouse barcoding was carried out seated at desks with books moving to and from the workstations in stacks of three plastic totes, placed on dollies. When required, safety clothing (dust masks, latex gloves, high-visibility jackets and steel toe-capped boots), conservation-grade ribbon and conservation-grade boxes were made available.

6 Staffing

6.1 Introduction

From the outset we knew that large numbers of staff would be required to deliver the project on time. The implementation phase of the project would not start until early 2010 and was due to be completed, with the ingest of the last item at the BSF, in December 2011. Our initial calculations indicated that if we were to work a typical working week – Monday to Friday – then we had about 450 working days to barcode the estimated 6.5 million items. That meant barcoding over 14,000 items per day (a target we eventually surpassed).

6.2 Agency staff

A series of trials in 2009 suggested that we would need 100 to 150 full-time equivalent (FTE) staff. It was not practically possible to fit that many people in the library stacks so we explored ways to increase daily output. Extending the working day gave us more time to achieve our target. A variety of local factors in the different locations prescribed the hours that could be worked and during the life of the project we established a nine-hour day although at some stages barcoding work was under way from 6 am to 9 pm.

We expected staff turnover to be high because of the repetitive nature of the work. The Bodleian Libraries' personnel department would not have had the resources to cope with the additional number of staff (approximately one-fifth of the existing staff numbers). With this in mind, we invited a number of local recruitment agencies to bid for a contract worth £1 million to supply staff for the first six months. Drawing on skills from the University's central purchasing section we were able to negotiate a good deal that fell within our budget expectations and would enable us to achieve our targets.

University of Oxford students were particularly targeted and encouraged to apply for the agency jobs, in order to cultivate a relationship between future Oxford alumni and the Bodleian Libraries.

6.3 Library staff

To manage, lead and support the agency barcoders we needed a team of staff employed by the Bodleian Libraries. The small group that designed and led the 2009 trials proposed two teams:

- Supervisors to manage the agency staff, direct the daily work, and take responsibility for achieving daily targets – Inventory Control Officers (ICOs).
- Technical staff to provide solutions for barcoding different categories of material, process escalations, and provide bibliographic support for the catalogue – Project Officers (POs).

Initially three people were appointed to each team. The project was headed up by a project manager and supported by a senior project officer who was seconded from his technical services role within the Bibliographic Maintenance section of the Bodleian.

Staff from other sections of the library contributed to the project, in particular the systems team who provided the technical management of the catalogue and developed the ReBar software. The project was also supported by existing administrative staff to deal with ordering supplies and processing agency invoices. It was very important to get this right because of the large amounts of money that were transacted every week.

The variety within the collections meant we had to be able to react to sudden, unpredictable changes in workflow and productivity. For instance, moving from one classification scheme to the next meant the number of books escalated to the project officers could increase by 500 %.

Learning as we went, we were able to promote some of the more skilled and experienced barcoders to desk-based work to deal with escalations by offering them a small increase in pay. This became the team of senior barcoders, who over the course of the project numbered over 50 individuals.

As we started barcoding periodicals, the quantity of data to be processed increased dramatically, and we were able to put a case together to enlarge the core project team. We appointed four FTE Assistant Project Officers (APOs) for six months to support the work of the existing team, two of whom stayed on a further five months.

With the planned launch of the new integrated library system in July 2011 and the very significant demands the project was placing on the systems team, we recruited a database programmer who joined that team to provide full-time support for the Inventory Control Project's technical work. Until this point we had significantly underestimated the amount of technical support we needed especially since any hold-up in the management of the catalogue could stall the project.

6.4 Training

Following barcoding trials, the main monograph and periodical workflows were documented. They were then revised as necessary to reflect the aims of the project and the management of different collections.

All training was delivered in-house by project staff employed by the Libraries. Training of new staff and re-training of existing staff was a significant task, because of staff turnover, the sometimes unpredictable nature of the material, and, not least, the introduction of a new library management system (Aleph) mid-project.

Senior barcoders were required to assess and solve problems as well as use the Geac and Aleph cataloguing modules. A manual of standard routines was created for their use and training delivered by POs and APOs using selected escalated material. Training was incremental to allow staff to become familiar with the routines and their work was reviewed by the POs until they were able to work independently.

Support for senior barcoders, who frequently encountered extremely puzzling material, was provided through an email helpdesk manned by the POs. In the course of their work, senior barcoders would identify rare and valuable items, as well as finding many books flagged on the catalogue as missing.

Along with the overview plan of how the collections would be managed, a certain amount of reactive work was also required as unexpected tranches of material were uncovered in the main collections and uncatalogued material came to be processed. This was to be expected when carrying out the first full inventory after several hundred years of acquisitions and required a flexible workforce, including teams of hand-picked staff trained in non-standard workflows to manage the unpredictable nature of what we found. This was particularly important in completing barcoding of the central Bodleian stacks and also the Deep-Store facility, where material could not be accessed for sampling and assessment before it arrived.

7 Challenges

7.1 Introduction

Despite seeking advice and using external consultants in the preliminary stages of the project, it became clear that nobody had ever embarked on a project of this scale and magnitude before, so venturing into the unknown would inevitably present us with problems and challenges.

Financial and human resources were significant challenges. At the outset the project had been funded with £1.5 million to get started and it was not until planning was complete and the implementation had been under way for six months that we were able to make realistic budget forecasts. The ability to adjust our staffing levels to react to short-term problems was a great benefit and we would not have been able to deliver the project on time without the flexibility of agency staff and the enormous dedication and hard work of the entire project's staff.

The challenges can be broadly grouped into three distinct areas: practical, technical and inter-project.

7.2 Practical challenges

All of the projects to transform the Bodleian Libraries were trying to achieve their goals with the common aim that there would be minimal disruption to existing services. Communication and building good working relationships with as many colleagues as possible proved to be the key to enable the Inventory Control Project to work alongside normal operations.

Engaging with staff enabled them to understand the difficulties we faced and we found them to be adaptable and willing to help to the extent that they often provided solutions. This was backed up by tremendous support for the project at the highest level. The main communication tool was a weekly email bulletin summarizing the work done in each location and describing the next steps for the week ahead. This was sent to 70 staff in all areas that were involved or affected by the project from Bodley's Librarian to reading room invigilators.

Examples of problems that we faced were:

- Health and safety: by working with existing staff in the barcoding locations and the Health and Safety Officer, we were able to overcome problems in access, fire safety and working conditions.
- Building access: security of the collections was very important. The Libraries had no experience of having large numbers of agency staff or contractors working in the building. By working with facilities management and curatorial staff we were able to understand those concerns and propose new ways of working.
- Space: we underestimated the amount of space required for project operations away from the books. Staff needed space for administration, training, desk-based work and break facilities. A solution to this came as staff were vacating parts of the New Bodleian Library as the project grew, and we were able to occupy that space.

- Location of barcodes: a principle of operation for the large-scale ingest of books at the BSF was that barcodes were placed on the front cover. Concerns about defacing were dealt with robustly using communication and negotiation skills.
- Special collections: some collections were to be stored at the BSF temporarily so a solution to barcoding without physically affixing the barcode to the item was needed. After testing a number of solutions proposed by special collections and Conservation and Collection Care staff the answer was to apply the barcode to an acid-free paper slip inserted inside the book.
- Software development time: the ReBar software and the periodicals barcoding solutions enabled efficient and productive progress. The staff time required to do this work was initially at the cost of other work but by making an investment in appointing a database programmer we were able to gain full-time support in this important area.
- Warehouse experience: none of the existing library staff had experience of establishing or running a warehouse operation for the barcoding of the DeepStore and Nuneham collections. Identifying this at an early stage enabled us to appoint experienced staff to fill this knowledge gap.

7.3 Technical Challenges

Because DeepStore material would arrive in palletized batches and was not presented on shelves, it was necessary to define what material would be arriving and when. A document known as the 'shopping list' was drawn up to replicate as closely as possible the shelfmark sequences, with dates for delivery. In this way ReBar batches were defined in advance to match the shopping list.

Although we could specify which boxes we required on which day, it was necessary for DeepStore to use the fastest picking and packaging flow possible in order to complete the move on time. This meant that we could not define the contents of individual pallets.

When barcoding monographs using ReBar, barcoders could find a starting point in the file and work through boxes of monographs, but periodical sequences could arrive on different pallets or on different days. To work around this, DeepStore supplied details of the pallet contents in advance, which were used to create pallet-specific spreadsheets for periodicals barcoding work.

In July 2011, the Bodleian Libraries introduced the Ex Libris integrated library system, Aleph, with two weeks' associated downtime for the transfer of catalogue data from the Geac system. This presented a number of challenges. We had to

keep agency staff working in order to complete the project on time and avoid losing highly trained and experienced staff, keep the BSF supplied with material for ingest and organize re-training of senior barcoders.

The DeepStore site contained a lot of material which we knew was either uncatalogued or would need to be processed outside of the main workflows. Arrangements were made for this material to be delivered in the final two weeks of the delivery schedule, so that it could be stockpiled for processing during downtime. To keep material flowing to the ingest benches in the BSF during this time, a collection of monographs which had already been barcoded was also retrieved from DeepStore.

In order to provide a seamless transition from Geac to Aleph, the Project Officer Team first attended the in-house training for the Aleph cataloguing, serials and circulation modules. The senior barcoders' manual was then re-written to reflect the workflows of the Aleph software. Training was cascaded down to senior barcoders during downtime using the Aleph test database and client, along with shifts allocated for practice time on the new software. This proved successful and meant that the senior barcoder teams were ready when the Aleph system went live on 21 July 2011.

The Nicholson sequencing key needed to be re-written by the systems team to work in Aleph, resulting in a time delay of two months between go live of Aleph and the start of barcoding monographs with AutoNext ReBar. With a little over 10 kilometres of Nicholson monographs in Nuneham Courtenay, as well as other complex shelfmark sequences that could not be handled by the internal sort algorithms on Aleph, this presented a serious challenge to keep a balanced flow of monograph and periodicals material arriving at the SERS warehouse for barcoding.

This was managed in three ways. Firstly, the order of monographs retrieved from Nuneham Courtenay was changed, bringing forward collections with simple shelfmark sequences. Secondly, a large lending collection of material with barcodes used for circulation placed inside the front cover was taken, as the barcodes could be used in the same way as the machine-readable shelfmarks in other collections. Finally, sequences of Nicholson monographs were identified where a longer classification number preceded a shorter one on the shelf, as described in the section on ReBar with AutoNext. This allowed monograph barcoding to continue at the correct rate until the key was developed.

When barcoded books arrived at the Book Storage Facility they were scanned against the pre-ingest file, a file of valid barcodes extracted from the library catalogue. If a physical item arrived with a barcode not present in the pre-ingest file, it was rejected as a 'Not On File' (NOF). This file was refreshed daily to include new barcoding work.

NOFs occurred for several reasons, one being when material barcoded by spreadsheet methods was shipped for ingest before barcoding data was uploaded to the catalogue. The solutions were to put a buffer of barcoded material in place to allow time for data to be uploaded to the catalogue and be harvested for pre-ingest, and to perform a quality check on material before it was sent to the BSF. In addition, NOFs were caused by lost data files and errors made in the barcoding workflows. The NOF error rate was 1.5 %.

NOFs were processed by the senior barcoders, based in the SERS warehouse and the BSF itself.

Another problem dealt with at the same time as NOFs was crossed-over barcodes. These were usually flagged up by a reader attempting to order one book but being sent another with the wrong title. This required two actions: re-barcoding of the book in hand to attach the barcode to the correct bibliographic record; and an audit of the trays containing the books at the BSF to search for the book requested by the reader.

Tray audits were carried out by BSF staff. The trays where the missing book might be were identified by looking for adjacent shelfmarks and barcodes. Those trays were checked to pick up any errors. An example of an error we hoped to pick up was those cases where ReBar work had become one step out from the shelfmark sequence, resulting in a series of books being associated with the following or preceding bibliographic record in the shelfmark sequence. This could be caused by missing books or books being out of shelfmark order at the time of barcoding, lack of barcoder attention and using AutoNext ReBar when machine-readable based methods of identification were available.

The inventory records created by the project were unfamiliar to readers and Reader Services staff. The Senior Project Officer produced a manual for using the records and provided technical support where necessary.

As the Inventory Control Project was completed, there remained an estimated 500,000 item records still mapping to now defunct stack locations and other areas of the New Bodleian building. Work will be ongoing to assess and categorize these records, many of which are for material barcoded on inventory records parallel to the catalogue, and pre-existing holdings records for periodicals. Once the above categories have been excluded, the remaining data will include all genuinely missing items as well as bibliographic duplicates. Work to resolve these records presents an excellent opportunity to complete the inventory of the Bodleian Libraries' collections now shelved in the BSF.

7.4 Inter-project challenges

The barcoding, book moving and BSF projects were part of a cluster of Academic Strategy projects (see chapter 1),[1] and although run separately, they were interdependent. Other projects included in the Academic Strategy were under way concurrently, including the launch of a new integrated library system, the refurbishment of the Underground Bookstore and the large project to refurbish the New Bodleian Library.

The very nature of the three interdependent projects meant we were operating as a supply chain, constantly feeding material into the BSF ingest programme. That process was always at the end of the chain but barcoding and bookmoving had different roles at different times.

When tackling the New Bodleian collections, barcoding was done ahead of the moves to the BSF. By having a seven-month head start, we were able to prepare many of the collections for the move, which would proceed at a much faster rate. In the weeks leading up to the completion of barcoding in this building, the bookmovers had caught up and were always hot on the heels of the barcoders. This sometimes resulted in delays and downtime for the bookmoves team.

During the Nuneham Courtenay barcoding operations in the SERS warehouse, the bookmovers were shipping unbarcoded material to the barcoders. The nature of the shelving at the Nuneham Courtenay repository limited the flow of material to the barcoders. Some collections were quicker to barcode than others which led to downtime for the barcoders. The continued uncertainty of the challenges each new collection would present made this a very difficult balancing act.

For whichever operation was in the middle of the chain, be it barcoding or bookmoving, it was very difficult to maintain a steady output of material because of the variety of problems that could disrupt the input to the process.

The programme for the Underground Bookstore project dictated that barcoding the collections there became our number one priority in the opening stages of the implementation of the project. This proved difficult because of the nature of the Nicholson-classified material and Official Papers stored there, our lack of experience in barcoding them and the very dense storage of collections in that space. It also quickly came to light that a considerable amount of uncatalogued material was stored there for which we had no solutions.

1 'Academic Strategy for Oxford University Library Services', *Oxford University Gazette* (26 June 2009), accessed 29 June 2012, http://www.ox.ac.uk/gazette/2008-9/weekly/260609/notc.htm#5Ref.

We increased our staff resourcing and increased our working day to 15 hours. We quickly devised new solutions which were later refined. For example, the 'publisher dump' method was first developed to barcode the series of Penguin and other paperback books stored in the Underground Bookstore.

Barcoding of the collections stored in the DeepStore salt mine was originally scheduled as the last part of the project. When the Libraries realized that a saving of several hundred thousand pounds would be made by removing the material early, the work was brought forward to the beginning of 2011. The associated operations have already been described – our challenge was to fit this into the already busy workload. We already had experience of running parallel operations but not of the scale proposed, where we would effectively double our throughput.

An opportunity to restructure and enlarge our core project team and the ability to call on additional agency staff provided the solution. We were able to put in place more rigorous selection criteria for the recruitment agency and spread our existing barcoding teams across two locations which gave us a small team of experienced barcoders in both locations, and divided the training effort into more manageable units.

8 Achievements

All the planning activity including the initial analysis of the collections had estimated that there would be 6.5 million books to barcode. In early 2011 it started to become apparent that we might exceed this total given the rate of barcoding and the extent of the collections which were completely uncatalogued. The last item to be barcoded brought the total to 7,049,741.

It is difficult to envisage this number of items. The achievements of the project are better described in more tangible ways. For example, there were 446 working days during the life of the project, meaning that on average 15,806 books were barcoded each day.

One of the methods used to chart progress externally, and to convey it to staff and readers, was to consider the task in terms of the linear shelf space that the collections would occupy. The task was to barcode 192 kilometres of stock which is, coincidently, the same distance from Oxford to the birthplace of Sir Thomas Bodley (the Bodleian Library's founder) in Exeter, Devon. Using Google maps and small adjustments to the figures to enable us to use Street View, we described his journey to Oxford in terms of the linear length barcoded. The journey can be seen on the Bodleian Libraries' website, http://www.bodleian.ox.ac.uk/about/projects/completed-projects/barcoding (See Figure 2.5).

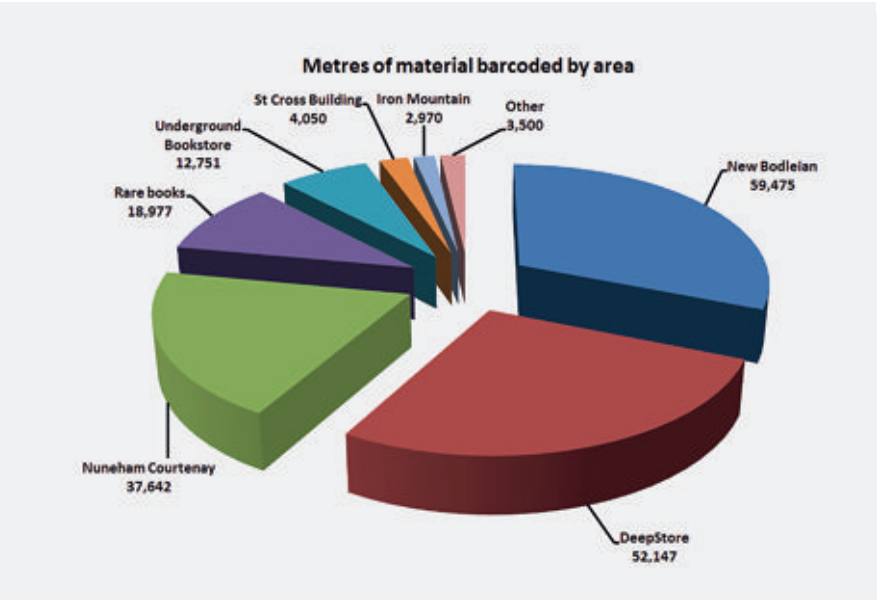

Figure 9.5: Chart of metres of material barcoded by area

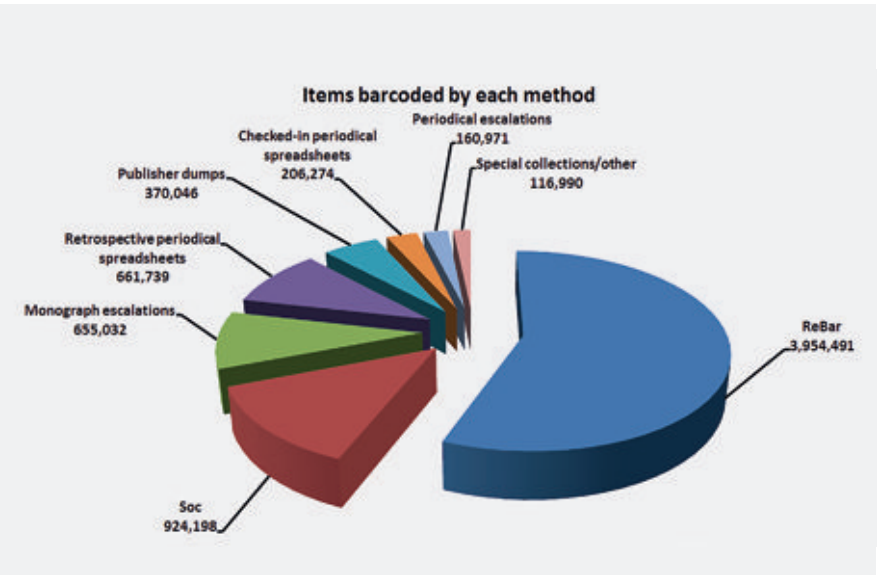

Figure 9.6: Chart of items barcoded by each method

A variety of different collections spread across multiple locations were barcoded. The graph (Figure 9.5) summarizes our work with almost three-fifths of the material (58%) coming from the New Bodleian bookstack and the DeepStore salt mine.

The considerable investment of resources in developing the ReBar software clearly paid off: just under four million monographs were barcoded this way, representing 56% of the total amount barcoded.

The work undertaken by the senior barcoders and the employed project team was very significant. A total of 655,032 escalations were processed representing 9% of the total. This included 288,959 item records that were added for books which were previously inadequately described, thereby enhancing the granularity of the holdings. A total of 56,598 bibliographic records were added for material that was previously uncatalogued, and during the course of the project 4,793 books that had previously been recorded as missing were found.

No library had ever set out to barcode so many books in such a short period of time. We invented new processes that had to be scalable and to continuously evolve and adapt. (Figure 9.6) Pragmatic decisions were made to ensure we completed the project on time and this would sometimes compromise on the existing culture of perfectionism. In a project of this scale, there was a risk that a barcode might be mismatched with the title or volume. We set ourselves the target of an acceptable mismatch error rate of 2% and in the event achieved a rate of less than 1%.

We achieved greater descriptive granularity in the catalogue and with every item barcoded we have improved inventory control for the Bodleian Libraries' collections, enabling faster and more accurate retrievals. This enhanced bibliographic control will provide better access to our collections and enable us to manage them more effectively.